

Checklist of marine algal floras from Paramushir and Shumshu (Northern Kuril Islands)

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Abstract

This study provides the most comprehensive checklist of marine macroalgae to date for Paramushir and Shumshu Islands (Northern Kuril Islands), based on recent field collections and a critical review of historical records. The resulting flora comprises 192 species (33 Chlorophyta, 115 Rhodophyta, 44 Phaeophyceae), extending the known flora of Paramushir by 17 species and that of Shumshu by 37 species. A standout finding is the discovery of *Alaria marginata*, which represents a first record for the entire Russian Far Eastern seas. Furthermore, we report a dense population of *Feditia simuschirensis* near Paramushir, indicating this kelp is not endemic to Simushir Island and necessitating a revision of its biogeographic status. In total, 17 species are newly reported for the Northern Kuril Islands, significantly enhancing the understanding of North Pacific phytogeography.

Keywords

Marine macroalgae, algal flora, biodiversity inventory, checklist, biogeography, new records, Kuril Islands, Paramushir, Shumshu, Russian Far East

Introduction

The earliest documented account of macroalgae from the Northern Kuril Islands was published by Postels and Ruprecht (1840), featuring a description of *Eualaria fistulosa* (Dragon kelp), a species distributed across the northern Pacific. Their work was based on field observations from the round-the-world expedition led by F.B. Lütke (1826–1829). The first dedicated phycological collections in the region were made by the Japanese researcher K. Yendo, who prepared herbarium specimens from the Northern Kurils. From this material, he described the new laminariacean species *Hedophyllum spirale* (Yendo 1903), currently regarded as a synonym of *Hedophyllum bongardianum*.

In the 1930s, extensive phycological material was collected from the Kuril Islands, including Shumshu and Paramushir, by specialists from Hokkaido University (Sapporo, Japan). This collection formed the basis for several taxonomic descriptions of kelp species by Miyabe and Nagai (1932a, 1932b, 1933; Nagai 1933). Subsequently, Nagai synthesized the herbarium records amassed by Japanese collectors since the early 20th century to publish comprehensive accounts of the regional algal flora (Nagai 1940, 1941), listing 40 and 30 species from Paramushir and Shumshu, respectively.

Research was continued in the latter half of the 20th century by Russian phycologists. As summarized in Table 1, significant contributions were made by Zinova and Perestenko (1974), Gusarova et al. (1986, 1993), and Klochkova and Trofimova (2003). An analysis of these publications indicates that the primary collection sites were concentrated in the Second Kuril Strait, near the city of Severo-Kurilsk on Paramushir, and in the vicinity of the now-abandoned Baikovo village on Shumshu.

The present study aims to compile an updated checklist of algae for Paramushir and Shumshu islands by integrating existing literature with original data from field collections conducted in the summer of 2025. This synthesis has revealed 17 taxa newly recorded for these islands, including several rare and little-known species previously considered endemic to other regions.

Materials and methods

Algal specimens were collected during the Russian Geographical Society expedition "Eastern Bastion – Kuril Ridge" in summer 2025, in which one of the authors (N.G. Klochkova) participated.

Collections were conducted at two primary locations: **Paramushir Island:** Specimens were gathered from Krashenninnikov Bay on the island's Okhotsk Sea coast between July 24 and August 8, 2025 (Fig. 1). This site represents the first phycological survey of this locality. **Shumshu Island:** Specimens were collected along the island's northwestern coast from August 9 to August 18, 2025, encompassing coastal areas of both the Okhotsk Sea and Pacific sides (Fig. 1).

Specimens were hand-collected in the intertidal and subtidal zones down to a depth of 20 m using SCUBA diving. Diving operations were conducted by researchers T.I. Antokhina and Yu.V. Deart from the Institute of Ecology and Evolution, Russian Academy of Sciences (Moscow).

A total of 156 herbarium sheets of green, brown, and red algae were prepared. Voucher specimens have been deposited at the Kamchatka Branch of the Pacific Institute of Geography (KBPGI).

This study is based on morphological identification, without the application of DNA barcoding, synthesizing recent field collections with a critical review of historical records to compile a comprehensive checklist for Paramushir and Shumshu Islands. Species identification was performed using standard phycological methods. When necessary, anatomical verification was conducted by preparing free-hand cross-sections (3–8 μm thick) to examine diagnostic internal structures. Sections were observed and photographed using an Olympus BX-53 transmitted light microscope (Olympus, Japan) under various magnifications.

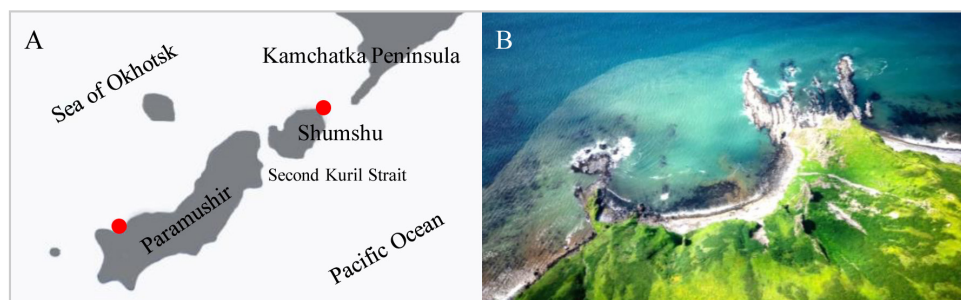


Figure 1. Sampling locations and habitat. (A) Map of Paramushir and Shumshu islands showing seaweed collection sites (indicated by red circles). (B) Representative view of the intertidal algae belt at the sampling site of Cape Skalny, Krasheninnikov Bay, Paramushir.

Results and discussion

Prior to this study, the documented marine algal flora of Paramushir and Shumshu islands comprised 167 and 81 species, respectively (Table 1). By integrating our 2025 field data with existing literature, we have expanded the checklist for the Northern Kuril Islands to 192 species, distributed among 33 Chlorophyta, 115 Rhodophyta, and 44 Phaeophyceae.

The systematics of marine macroalgae has undergone substantial revision in recent decades due to the widespread application of molecular-phylogenetic methods. These advances have prompted changes in the taxonomic placement of many species, as well as revisions to generic, familial, and ordinal classifications. Consequently, previous checklists for the Northern Kuril Islands (e.g., Klochkova & Trofimova 2003; Ogorodnikov 2007) required a comprehensive update to reflect current taxonomic consensus.

Table 1. First published records of marine algal species for Paramushir (Par.) and Shumshu (Shu.) islands

No	Authors	Year	Content of publication	Number of species	
				Par.	Shu.
1	Miyabe and Nagai	1932a	Descriptions of <i>Hedophyllum bongardianum</i> and <i>Laminaria</i> species	2	–
2	Miyabe and Nagai	1932b	Description of <i>Pleuropterum paradiseum</i>	1	–
3	Miyabe and Nagai	1933	Description of kelp species from the Kuril Islands known by 1933	6	–
4	Nagai	1933	Description of <i>Cymathaera</i> species	1	–
5	Nagai	1940	Description of green and brown algae from the Kuril Islands	24	20
6	Nagai	1941	Description of red algae from the Kuril Islands	36	20
7	Tokida	1954	Description of algal flora from Sakhalin	1	–
8	Kusakin et al.	1974	Description of tidal algal communities from Paramushir	1	–
9	Zinova and Perestenko	1974	Checklist of marine algal flora from the Kuril Islands	21	4
10	Vinogradova	1974	Revision of ulvacean algae	3	1
11	Perestenko	1975	Revision of red lamellar algae from Russian Far Eastern seas	1	–
12	Lee	1978	Taxonomic revision of Rhodymeniales	1	–
13	Masuda	1982	Taxonomic revision of Rhodomelaceae	–	2
14	N. Klochkova and Demeshkina	1985	Taxonomic revision of genus <i>Clathromorphum</i> from Russian Far Eastern seas	3	2
15	Gusarova and Semkin	1986	Checklist of marine algal flora from Russian Far Eastern seas	12	1
16	Gusarova et al.	1993	Checklist of marine algal flora from Russian Far Eastern seas	6	1
17	N. Klochkova	1993	Descriptions of rare protected species of marine algal flora from Kamchatka	1	1
18	N. Klochkova	1998	Checklist of marine algal flora from Russian Far Eastern seas	11	10
19	N. Klochkova and Trofimova	2003	Addition to marine algal flora from Paramushir	25	–

No	Authors	Year	Content of publication	Number of species	
				Par.	Shu.
20	Perestenko	1994	Taxonomic revision of Russian Far Eastern red algae	1	1
21	Ogorodnikov	2007	Addition to marine algal flora from Paramushir and Shumshu	7	18
22	N. Klochkova and Pisareva	2009	Taxonomic revision and description of Far Eastern <i>Constantinea</i> species	1	–
23	T. Klochkova and Klimova	2020	Distribution of <i>Agarum</i> species along Asian coast	1	–
Total				167	81

We present an updated and expanded checklist of the marine algal flora for Paramushir and Shumshu (Suppl. material 1: Table 2). This compilation includes all 192 species, with data on their distribution across the two islands and citations for their first reported occurrence in the region. Historical synonyms used in previous reports for these localities are also noted. The classification of genera into higher taxa (families and orders) was verified using the public database AlgaeBase (Guiry & Guiry 2025) and recent taxonomic literature.

Our investigation revealed 17 taxa newly recorded for these islands. Among the most notable findings are *Pseudochorda nagaii* (Fig. 2A), *Halosaccion americanum* (Fig. 2B), *Alaria marginata* (Fig. 2C, D), *Feditia simuschirensis* (Fig. 2E, F), *Constantinea simplex*, *Gloiocladia guiry*, and *Phycoflabellina avachensis*. These records have significant biogeographical implications: *Pseudochorda nagaii* was previously known only from the Sea of Japan and the southern Sea of Okhotsk. *Feditia simuschirensis* was previously considered an endemic species of Simushir Island in the Middle Kurils. Its discovery on Paramushir suggests a broader distribution along the Kuril Ridge, necessitating a re-evaluation of its endemic status. The remaining species were hitherto reported only from the Commander Islands or southeastern Kamchatka, indicating a more extensive northwestern Pacific distribution.

A detailed anatomical and morphological analysis of *F. simuschirensis* from this new locality will be presented in a future publication.

Conclusions

Following the taxonomic analysis of new phycological material and a critical review of existing literature, the documented algal flora of Paramushir Island has been expanded by 17 species, and that of Shumshu Island by 37 species.

Our study documents 17 taxa newly recorded for the Northern Kuril Islands, significantly updating the regional checklist. These include: the green alga *Schizogonium murale* (supratidal zone); the brown algae *Dictyosiphon foeniculaceus*, *Pseudo-*

chorda nagaii, *Agarum* sp., *Feditia simuschirensis*, and *Alaria marginata*; and the red algae *Bangia atropurpurea*, *Bossiella compressa*, *Constantinea simplex*, *Velatocarpus pustulosus*, *Halosaccion americanum*, *Sparlingia stipitata*, *Gloiocladia guiry*, *Meiodiscus concrescens*, *Neohypophyllum middendorphii*, *Phycoflabellina avachensis*, and *Reingardia laminariicola*.



Figure 2. Macroalgal species newly recorded for the Northern Kuril Islands. (A) The brown alga *Pseudochorda nagaii*. (B) The red alga *Halosaccion americanum*, showing its typical tight attachment to rocks in the intertidal zone. (C, D) The brown alga *Alaria marginata*, illustrating key morphological characters: nearly black stipes with flattened holdfasts (C) and thick, dense, elongated sporophylls (D). (E, F) The rare brown alga *Feditia simuschirensis*, shown as part of an underwater community (E) and as an individual specimen (F).

The marine algal flora of the Northern Kurils is now recognized as comprising 192 species, representing 23 orders, 46 families, and 114 genera. This diversity underscores the region's phycological significance. Future research is expected to further augment this checklist, particularly through the study of under-reported groups such as coralline algae, as well as microscopic epiphytic and endophytic species.

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Supplementary material 1

Table 2. Checklist of algal species from Paramushir and Shumshu (Northern Kuril Islands)

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Data type: table

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